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May 25, 2023 Reference No. 2111-W043

1334281 Ontario Limited
720 Granite Court
Pickering, Ontario
L1W 4A3

Attention: Mr. Domenic Grossi

Re: Pre- and Post-Development Water Balance Assessment
Proposed Mid-Rise Residential Development
720 Granite Court
City of Pickering

Dear Sir:

Soil Engineers Ltd. (SEL) was retained to complete a pre- and post-development water balance assessment and an associated mitigation plan for the captioned mid-rise residential development site in City of Pickering and our findings and recommendations are presented in this letter report.

o Introduction

The subject site is located720 Granite Court, which is located northwest of the intersection of Granite Court and Whites Road South in the City of Pickering. The location of the site is shown on Drawing No. 1. The surrounding land uses consists of a highway the north, Whites Road South and existing residential and commercial properties to the east, Granite Court and existing residential properties to the south, along with a railway line and commercial/industrial properties to the west. Based on the updated architectural plan, dated February 14, 2023, project number 22035, prepared by Onespace Unlimited Inc., the proposed development is anticipated to be completed with a 12-storey high building over 2-levels of underground parking structure.

- **Background**

SEL previously completed a hydrogeological investigation for the subject site, (SEL Reference Number 2111-W043, dated March 2023). A review of the borehole logs drilled on site indicates that beneath a layer of topsoil, the native subsoils underlying the subject site consists of sandy silt till, extending to the maximum depth of investigation at 12.3 m below the prevailing ground surface (mbgs). Groundwater levels were measured within the monitoring wells to record the fluctuation of the groundwater table beneath the site over the monitoring period, covering the dates, extending between January 7 and February 1, 2022. The recorded groundwater levels were noted to be between the depths of 3.61 and 8.24 m below ground surface or at an elevation, ranging from between 100.38 and 96.16 masl.

- **Water Balance Assessment**

The subject site is located within the Toronto Source Water Protection Area. As requested, a pre- and post-development water balance and an associated mitigation plan is provided to maintain the pre-development water balance for the subject site prior to it receiving development approval. The water balance assessment for this proposed development is based on the following equation:

$$P = ET + R + I + \Delta S$$

Where:

P -- Average Annual Precipitation

ET -- Evapotranspiration

R -- Surface Water Runoff

I -- Infiltration

Δs -- Change in Groundwater Storage, taken as 0

- **Precipitation**

The Toronto and Region Conservation Authority (TRCA) TRSPA tool was used for the current pre- and post-development water balance assessments. The water balance calculations for the subject site are summarized in the Appendix. Based on the TRCA tool; (https://trca.ca/conservation/drinking-water-source-protection/trspa-water-balance-tool/),

a precipitation rate of 865 mm/year was considered for the subject site which was used for the current pre- and post-development water balance assessments.

- **Interception**

Based on the adoption of the SWM Planning and Design Manual (MECP, 2003), evapotranspiration includes the evaporation from all sources; including; precipitation, water, snow, vegetation and from water droplets on plant surfaces plus the transpiration from plants, not involving water droplets retained on leaves. As such, interception was not included for the current pre- and post-development water balance assessments as it has been included in the estimate for evapotranspiration.

- **Groundwater Storage**

Although groundwater storage experiences gains and losses on a short-term basis, the net change in groundwater storage (Δs) over the long-term is generally zero. For this reason, the change in groundwater storage is shown as zero (0) which has not been included in the water balance calculations.

- **Evapotranspiration**

In general, evapotranspiration (ET) refers to the transfer of water from vegetation and from the soil surface to the atmosphere in the form of water vapor. The term considers evaporation from the soil surface, and from man-made infrastructure surfaces (asphaltic and concrete roads and building roofs), together with the transpiration and interception from plants and trees because of the difficulties in separating these processes. Potential evapotranspiration (PET) refers to the transfer/loss of water from vegetated surfaces to the atmosphere under the condition of unlimited water supply. The actual rate of evapotranspiration (AET) is generally less than PET under dry conditions (i.e., during the summer season when there is a soil moisture deficit). Use of the TRSPA tool suggests that an ET value of 506 mm/year, which has been adopted for the subject site.

- **Infiltration and Runoff**

TRSPA Tool suggests an infiltration recharge rate of 54.56 mm/year can be adopted for the site. However, a modified infiltration rate of 269.25 mm/year was considered for the current

water balance assessment, which is based on the MECP infiltration factors and the water surplus factor of 359.00 mm/year or (P-ET) for the site. The water surplus estimate for this assessment is the difference between average precipitation value of 865.00 mm/year and the TRSPA derived estimate for ET of 506.00 mm/year, giving a water surplus estimate of 359 mm/year, which was used for the pre and post water balance calculations. Details of the assessment are presented in the Appendix, on pages 1 of 3. Table 2 summarizes the infiltration and runoff estimates based on the considered approach.

The TRSPA Tool suggests a runoff rate of 308.00 mm/year for the subject site. This value was modified to a runoff factor of 89.75 mm/year, which is also based on the water surplus estimate of 359.00 mm/year times 1 minus the cumulative infiltration factors, or (1-0.75) (Table 2), which were also considered for the current estimation to conform with the precipitation and ET rates that were adopted from the TRSPA tool and used for the assessment. The average annual depth estimates for infiltration and runoff for the site are given in Table 1. The water balance depth estimates for the infiltration and runoff component used for the current assessment are provided in Table 2.

The TRSPA tool derived infiltration and runoff depth estimates were not used since the sum of these estimates along with ET do not add up to the TRSPA tool derived estimate for precipitation.

Table 1 - Summary of Water Balance Components that were Adopted from the TRCA TRSPA Tool And Modified Based on the MECP Infiltration Factors for the Site

Precipitation (mm/year)	Evapotranspiration (mm/year)	Runoff (mm/year)	Infiltration (mm/year)
865.00	506.00	89.75	269.25

Runoff from impervious surfaces is calculated differently than runoff from pervious soil/vegetated covered surfaces. As a general rule, the ET from impervious surfaces, on an average annualized basis is calculated, by taking 10% of the average annual precipitation, while runoff is calculated by taking 90% of the average annual precipitation. The subject site is currently vacant, which is covered with grass and weeds. Impervious surfaces are being proposed for construction at the development site. As such, the ET and runoff depth

estimates on an average, annualized depth basis for the proposed impervious areas are 86.50 mm/year and 778.5 mm/year, respectively.

Table 2 - Summary of Infiltration and Runoff Estimation

Land Characteristics	MECP Infiltration Factors	Water Surplus Estimate (mm/yr)	Infiltration Estimate (mm/yr.)	Runoff Estimate (mm/yr.)
Soil: (sandy silt till)	0.30	**359.00**	I = 0.55×359.00	R = (1-0.75) ×359.00
Slope: (flat land)	0.30			
Vegetation Cover: (Grass land)	0.15			
Cumulative Infiltration Factor	**0.75**		269.25	89.75

- **Pre-Development Water Balance**

Since there are no pre-existing structures or paved areas within the undeveloped subject site, the pre-development water balance for the site was calculated by multiplying the existing undeveloped site areas by the various, averaged annualized depth estimates for Precipitation, ET, infiltration and Runoff. The average annual volumetric estimates for each pre-development water balance component are given in Table 3.

Table 3 - Summary of Pre-Development Volumetric Water Balance Components

Pre-Development Site Areas	Area Coverage (m^2)	Precipitation (m^3/year)	AET (m^3/year)	Infiltration (m^3/year)	Runoff (Pervious) (m^3/year)
Pervious Areas (Entire Site)	11,848.00	10,248.52	5,995.09	3,190.07	1,063.36
Total Area/Volume	**11,848.00**	**10,248.52**	**5,995.09**	**3,190.07**	**1,063.36**

The pre-development water balance components for the site were calculated on an annualized depth basis by dividing the volumetric estimates for each water balance component, from above by the total site area. Based on this approach, the depth-based water balance components are presented as follows:

P (865.0) = ET (506.0) + I (269.25) + R (89.75)

- **Post-Development Water Balance**

Based on a review of the Functional Servicing and Stormwater Management Report, prepared by Masongsong Associates Engineering Limited, MAEL Reference 22-104, dated May 2023, the proposed development will consist of the construction of 12-storey. mid-rise condominium development. A review of Dwg No. 3 from Appendix 'C', from the above-mentioned report indicates that the site comprises a total area of 11,848.00 m^2. Of this area 2,338.0 m^2 will be developed into the proposed building roof top, 3,616.00 m^2 will be paved, impervious areas, and the remaining area of 5,894.00 m^2 will be grassed/landscaped/ and uncontrolled runoff areas.

The post-development water balance was calculated using the same, depth-based components that were used for the pre-development water balance calculations, i.e., average annual precipitation and average annual ET. Following site development, with no infiltration through the impervious areas, the depth estimates for runoff and ET become 90% and 10% of the average annual precipitation, respectively, giving depth estimates of 86.5 mm/year and 778.5 mm/year for ET and runoff respectively for proposed impervious developed surfaces. The estimated post-development water balance volumes for the developed site are provided, as follows in Table 4:

Table 4 - Summary of Post-Development Volumetric Water Balance Components

Post-Development Site Areas	Area Coverage (m^2)	Precipitation (m^3/year)	AET (Impervious) (m^3/year)	AET (Pervious) (m^3/year)	Infiltration (m^3/year)	Runoff (Pervious) (m^3/year)	Runoff (Impervious) (m^3/year)
Impervious Areas (Housing Area)	2,338.00	2,022.37	202.24	0.00	0.00	0.00	1,820.13
Impervious Areas (Driveways)	3,616.00	3,127.84	312.78	0.00	0.00	0.00	2,815.06
Pervious Area (Grassed/Landscaped/ Uncontrolled Area)	5,894.00	5,098.31	0.00	2,982.36	1,586.96	528.90	0.00
Total Area/Volume	**11,848.00**	**10,248.52**	**515.00**	**2,982.36**	**1,586.96**	**528.90**	**4,635.20**

From the volumetric water balance estimates presented in Table 4, the depth-based post-development water balance estimates were determined after dividing volumetric total

amounts by the total site area, presented as follows:

$$P\ (865.0) = ET\ (295.2) + I\ (133.9) + R\ (435.9)$$

Comparison of the pre- and post-development water balances shows a decrease of 210.8 mm/year, or 41.7 %, in annual evapotranspiration, a decrease of 135.3 mm/year, or 50.3 %, in annual infiltration, and a gain in runoff of 346.1 mm/year, or 485.6 %.
The volumetric comparisons of evapotranspiration, infiltration and runoff between the pre-developed and post-developed site are summarized in Table 5. A review of the findings indicates that after development, decreases of 2,497.72 m^3/year and 1,603.07 m^3/year are anticipated for ET and infiltration, respectively. An increase of 4,100.74 m^3/year is also expected for runoff for the post-developed site compared with the pre-developed site.

Table 5 - Comparison Summary of Pre- and Post-Development Water Balance/ Budget Components

	Precipitation (m^3/year)	ET (m^3/year)	Infiltration (m^3/year)	Runoff (m^3/year)
Pre-development	10,248.52	5,995.09	3,190.07	1,063.36
Post- development	10,248.52	3,497.36	1,587.00	5,164.10
Volumetric Change in Pre- and Post-Development Water Balance Parameters		-2,497.73	-1,603.07	+4,100.74

- loss
+ gain

- **Water Balance Mitigation Plan**

The difference between the pre- and post-development water balances can be attributed to establishment of impervious surfaces such as the access road, sidewalks driveways, and the building footprint rooftop area. For the design of Low Impact Development (LID) infrastructure to maintain the predevelopment water balance, the permeability for the surface soil is considered as being moderate. Bio-retention swales, soak-away pits, permeable pavement and thickening of topsoil within the green landscaped areas in conjunction with other LID methods could be considered to divert storm runoff away from the municipal storm sewer, and to recharge the groundwater table where possible.

Based on review of the hydrogeological report for the subject site (SEL Reference No. 2111-W043), groundwater levels were measured within the monitoring wells to record the fluctuation of the groundwater table beneath the site over the monitoring period, covering the dates of between January 7 and February 1, 2022. The recorded groundwater levels were noted to be between the depths of 3.61 and 8.24 m below ground surface or at elevations, ranging between 100.38 and 96.16 masl.

Based on the updated architectural plan, dated February 14, 2023, project number 22035, prepared by Onespace Unlimited Inc., the proposed development is anticipated to be completed with 12-storey high building over 2-levels of underground parking structure. An area of 2,338.00 m^2, has been considered as rooftop/building area, and an area of 3,616.00 m^2, has been considered as driveways and walkways (paved area), following site development. The anticipated runoff volumes, derived from the rooftop and paved areas (i.e. 90% of annual precipitation) are provided in Table 6.

Table 6 - Anticipated Volumetric Runoff from Proposed Rooftops and Paved Areas

Proposed Building Rooftop/ Paved Areas	Approximate Area Coverage (m^2)	Runoff Rate (mm/year)	Estimated Runoff (Building Areas and Paved Areas) (m^3/year)
Impervious Areas (Housing Area)	2,338.00	778.5	1,820.13
Impervious Areas (Driveways)	3,616.00	778.5	2,815.06
Total	**5,954.00**	**778.5**	**4,635.19**

Given that about 2,338.00 m^2 of the subject site will be developed as housing building areas, and about 3,616.00 m^2 will be developed as paved driveway areas, the estimated runoff volumes could reach a maximum of 1,820.13 m^3/year and 2,815.06 m^3/year for each of these areas respectively.

As provided by the Functional Servicing and Stormwater Management (FSSWM) Report, prepared by Masongsong Associates Engineering Limited, a cistern is being proposed to capture rainwater from the rooftop areas which will eventually be used for irrigation purposes on site to meet 5mm water balance target. Given the total impervious area post development will cover about 5,954.00 m^2, to meet 5 mm water balance criteria calculated

volume required to maintain on site works out to be 29.77 m^3 (5,954 m^2 x 0.005 m). Section 6.5 of FSSWM report, reflecting information from a site irrigation usage report confirms that the proposed irrigation system will require a total volume of 134 m^3 during 72 hours of portable water during the irrigation months through evapotranspiration and water usage within the site; and therefore, ensuring that the water balance target objective can be met entirely with the site irrigation within the private lands.

Any proposed thickening of topsoil within landscaped areas of the site is also recommended as an additional passive LID measure to retain runoff, to promote shallow infiltration for the maintenance a portion the site' pre-development water balance following site development.

We trust that this updated report will meet your current requirements and ask that you contact the undersigned should you have any further inquiries

Yours truly,
SOIL ENGINEERS LTD.

Harshpinder Brar

Harshpinder Singh Brar, M.Eng., EIT
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ENCLOSURES

Site Location Plan..... .....Drawing No. 1
Post Development Water Balance Assessments ....Appendix 'A'

N

Approximate Boundary of Subject Site

Watercourse

Expressway/Freeway

Major Road

Local Road

Railway

Soil Engineers Ltd.

Title: Site Location Plan

Project:

Hydrogeological Assessment
Proposed Mid-Rise Residential Development
720 Granite Court
City of Pickering

Reference No. 2111-W043

Date: January 19, 2022

Scale:

0 25 50 100 150 200 250

Metres

Drawing No. 1

720 Granite Court, Pickering
Precipitation, Recharge, Runoff and Infiltration Rates adopted from TRCA TRSPA Tool

Address	Precipitation (mm/yr)	ET (mm/yr)	noff (mm/	/Recharg	ET+Runoff+Infiltration (mm/yr)
TRSPA Tool	865.00	506.00	308.00	54.56	868.56
Modified	**867.00**	**506.00**	**89.75**	**269.25**	**865.00**

Source: https://trca.ca/conservation/drinking-water-source-protection/trspa-water-balance-tool/

720 Granite Court, Pickering

720 Granite Court, Pickering

Evapotranspiration Adopted from TRSPA WB TRCA tool	**506.00** mm/yr
Modified Infiltration Adopted from TRSPA WB TRCA tool	**269.25** mm/yr
Modified Runoff Adopted from TRSPA WB TRCA tool	**89.75** mm/yr

Avg Annual Precipitation	**865.00** mm/yr	Adopted from TRSPA WB Tool

ET	impervious surfaces	0.1	10%
R	pervious surfaces	0.9	90%

Type	MOECC Factors Grass Covered and Wood Lot	
Cover	0.15	grass/weed
Topography	0.3	flat
Soils	0.3	sandy stil till
MOECC Infiltration	0.75	

Future Developed Site Areas	Areas	Impervious factor	Assigned ET Pervious Portion	Water Surplus	Infiltration - Pervious Portion	ET - Impervious Portion	Runoff - Impervious Areas	Runoff Pervious Portion	precipitation	Pervious Area: Infilt Vol. Pervious Areas	Pervious Area: RO Vol. Pervious Areas	Pervious Area: ET Vol Pervious Areas	Impervious Area: RO Vol. Impervious Areas	Impervious Area: ET Vol Imperv Areas	Total Et and Ro.: Total ET	Total Et and Ro.: Total RO
	m^2		mm/yr	mm/yr	mm/yr	mm/yr	mm/yr	mm/yr	m^3/yr	m^3/yr	m^3/yr	m^3/yr	m^3/yr	m^3/yr	m^3/yr	m^3/yr
Proposed Impervious Areas (Building)	**2,338.0**	1.0	**0.0**	**778.5**	**0.0**	**86.5**	**778.5**	**0.0**	**2,022.4**	**0.00**	**0.00**	**0.00**	**1820.13**	**202.24**	**202.24**	**1820.13**
Proposed Impervious Areas (Parking and Driveway)	**3,616.0**	1.0	**0.0**	**778.5**	**0.0**	**86.5**	**778.5**	**0.0**	**3,127.8**	**0.00**	**0.00**	**0.00**	**2815.06**	**312.78**	**312.78**	**2815.06**
Proposed Pervious Areas-Landscaped Areas	**5,894.0**	0.0	**506.0**	**359.0**	**269.3**	**0.0**	**0.0**	**89.8**	**5,098.3**	**1586.96**	**528.90**	**2982.36**	**0.00**	**0.00**	**2982.36**	**528.90**
Total Area	11,848.0							**Total**	**10,248.5**	**1587.00**	**528.90**	**2982.36**	**4635.20**	**515.00**	**3497.39**	**5164.09**
									Totals				**Total RO**	**5164.10**	**Total ET**	**3497.36**

Parcel A: Post Development Water Balance/Budget

P	=	ET	+	I	+	R	+	ΔS		Check
865	=	**295.2**	+	**133.9**	+	**435.9**	+	**0.0**		**865.0**

Pre Development Water Balance/Budget

P	=	ET	+	I	+	R	+	ΔS		Check
865	**=**	**506**	+	**269.3**	+	**89.8**	+	**0.0**		**865.0**

		ET		I		R	ΔS
Loss/Gain in Post	loss:	**210.8**	loss:	**135.3**	gain:	**346.1**	0
	% loss:	**41.7**	%loss:	**50.3**	%gain	**485.6**	

Source: https://trca.ca/conservation/drinking-water-source-protection/trspa-water-balance-tool/